

ART. XVI.—*On some Tertiary Rocks at Portland Bay.* By
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[Read before the Institute 26th October, 1859.]

IN a paper read before the Institute last year I described the tertiary formation at Guichen Bay. I have now to deal with the same formation on a different part of the coast, seen in connection with two others. At Portland Bay (the most westerly port in the colony of Victoria) there is a remarkable exception to the general character of Australian coast scenery. Instead of the long ridges of sand, covered with scanty vegetation, and scattered salt-bush, the coast is bold, rising to fine bluffs on the northern side of the bay. In the centre of the port, and on the left of the town of Portland, there is a high bluff, having very much the appearance of a chalk cliff. It is capped by a thin stratum of shingle, and above this lies red clay. On the north side and on the right of the town there is a high cliff of red clay. This is the Flagstaff Hill, and on its summit a lighthouse is in course of erection. A little past this at a short distance from the road there are a series of islets called the Lawrence Rocks. These are volcanic. Further on at a small distance is Cape Grant. Here the cliffs are of quite a different character to those found in the bay. They are based on a thick stratum of basalt; and above these to the thickness of about 100 feet, the formation is the same as that described at Guichen Bay. This is a calcareous sandstone, which I shall, for convenience, term "crag." These three localities contain the rocks forming the subject of the present paper. To return to the white chalk cliff in the middle of the bay. This is called Whalers' Bluff. It is formed of a loose friable white limestone. This is the lowest of the three formations, because it is capped by the decomposed trap rock which underlies the crag. It contains few or no perfect fossils. All that we found were disposed in their seams about a foot apart, much broken, as if borne from a distance before being stratified, in what must have been a white calcareous mud. There can be no doubt that this forms a portion of the coralline strata found at Mount Gambier; and is a portion of an immense deposit extending over nearly a third part of the continent of Australia. It is continuous

right up to the River Murray, and thence may be traced westward (from the sea coast to about 100 miles inland) to the foot of the great dividing range which runs north and south from the bend of Lake Torrens to Cape Jarvis. On the east of this range it may be traced right along the great Australian Bight. Here it appears in tall white cliffs containing fragments of coral, and its appearance led Captain Flinders to believe that this portion of Australia was an up-raised atoll, and that an inland sea would be found the other side. The whole formation owes its origin to detritus from a coral reef. The further north, and the warmer the latitude into which it is traced, the more perfect the fauna become.

The reason, therefore, that fossils are so broken and so scarce at Portland Bay, is because the latitude was too cold for the reef to have flourished there, so that all that are found have been brought from a distance, and consequently broken in the transit. However, many beautiful novelties in polyzoa have been discovered by me in a very perfect state, and have been duly forwarded to the Geological Society of London. I propose to do no more in this paper than merely allude to the formations; and, therefore, will pass on to the next, after observing that the formation is of the Eocene or Lower Miocene period, and does not extend much to the eastward of Portland Bay, unless perhaps at Port Fairy. A mere seam is all that is found further east.

Above this is a stratum of decomposed trap. This is continuous with the same deposit at Flagstaff Hill and the basalt under Cape Grant. Probably it has flowed from a sub-marine crater which, to all appearance, has existed very near the Lawrence Rocks, for all around that locality a thick stratum of trifa, enclosing fragments of scoriæ, is found. There is no coralline found above the trap; but the crag immediately succeeds. The manner in which it is decomposed varies very much in different localities. Thus near the Whalers' Bluff it is greyish white, coarsely granular, and possesses large concentric circles of oxide of iron. At Flagstaff Hill not a trace of its former crystalline texture remains. It is decomposed into a deep bed of red ferruginous clay. At the Lawrence Rocks the lava is as white as the limestone. It powders easily, and sometimes contains disseminated crystals of mica and selenite.

At Cape Grant the line of junction between the trap and the crag is not easily traced. The limestone from above has been filtered down over the surface of the rock, so as to

encrust it with a thick coating of stalagmite. Huge boulders lie at the foot of the cliffs. They are water-worn and very vesicular. It is not, however, at all decomposed, and the only effect time has had upon it is to fill every available crevice with lime. In fact, it is an amygdaloidal lava. A small fragment of this infiltrated trap looks precisely as if it were studied with lentils of wax. Some of the larger vesicles contain very red acicular crystals of carbonate of lime, radiating from the centre towards the circumference. There can be no doubt it has flowed under the sea, and the huge hills and valleys which it seems to have covered, show that the bottom could not have been very level at that time. As the coral strata must have been deposited while the bottom was subsiding, the volcanic disturbance most likely created a change, and gave rise to elevation. This explains why no coralline is found above the trap; for the same effect which caused it to be covered, rendered the surrounding circumstances no longer favorable to its growth.

Immediately above the trap occurs the crag. This has been already described; but there is a reason why it should be slightly dwelt upon now. In the first place, it shows very clearly that the lava was not of sub-aerial origin, these strata having been formed under the sea. The strata, properly speaking, are about twelve feet thick, and are much contorted. This is not from the manner in which they have been upheaved, for no two strata correspond. The lower ones are sometimes horizontal, while those immediately above are waved and undulating. Between these great divisions of the strata there are cross laminations dipping in every direction. All these facts, and the nature of the stone, which is composed of calcareous sandstone, shows that the deposit was formed by a deep-sea current. As on each side of Cape Grant there are rises of trap rock, the thickness of the beds may be due to a valley in the sea bottom, in which sediment would more easily collect. The crag here, as at Guichen Bay, contains the root like concretions. They are termed roots, and so great is their resemblance to the name they bear, that it is extremely difficult at first to explain their purely aqueous origin. Darwin mentions a similar appearance on the Bald Head in Western Australia. He considers them in that place to be really vegetable casts. He supposes sand to have drifted round bushes and trees, and subsequently consolidated, and when the wood decayed away, the hollows became filled up by infiltrated lime, which being harder than

the surrounding matter, resisted the decomposition which has attacked the latter; and now they stand out like roots or trees. Mr. Darwin found many land shells round them, which quite bears out his view of their sub-ærial origin. But at Cape Grant nothing of the kind is visible. The so-called roots may often be traced many feet through different strata, and are quite as thick at the bottom as at the top. Besides, there is evident proof that there has been nothing but upheaval since the trap was deposited; and as a great part of the crag, even now, lies beneath the sea, there has been no opportunity for trees to grow where the supposed roots are found. I believe such formations as the crag are common on the whole coast westward as far as Western Australia; and it is just what we might expect to follow the extension of a great coral deposit before the site of the coral reef was raised into dry land.

I have now described the tertiary rocks at Portland Bay. My object has been only to draw attention to the rocks that are there visible, in order that future investigators may have a clear idea of their sequence and nature, in any examination they may make of the locality.

ART. XVII.—*On a new Photo-Lithographic Process.* By
JOHN WALTER OSBORNE, Esq.

(With an illustrative Map.)

[Read before the Institute 30th November, 1859.]

PHOTOGRAPHIC science has of late years made such astonishing progress, that it has stimulated the inventive genius of scientific men, awakening in them the very natural wish to make its many advantages applicable to the several graphic arts. The result has been the more or less perfect development of a number of processes bearing directly upon the reproduction of works of art.

Thus the application of photography to engravings has been the object of Mr. Fox Talbot's exertions; Niepce de St. Victor and Mr. Pretsch are also working in the same direction; while several gentlemen, of whom I shall subse-